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PEZESHKI, Bardia; 2404 Roosevelt Avenue, Redwood City, CA 94061 (US). **VAIL, Edward**; 894 Roble Avenue, Menlo Park, CA 94025 (US). **ZIARI, Mehrdad**; 3615 Portsmouth Court, Pleasanton, CA 94588 (US).

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(74) Agent: **CAROTHERS, W., Douglas**; SDL, Inc., Legal Affairs and Intellectual Property, 80 Rose Orchard Way, San Jose, CA 95134-1365 (US).

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(71) Applicant: **SDL, INC.** [—/US]; 80 Rose Orchard Way, San Jose, CA 95134-1365 (US).

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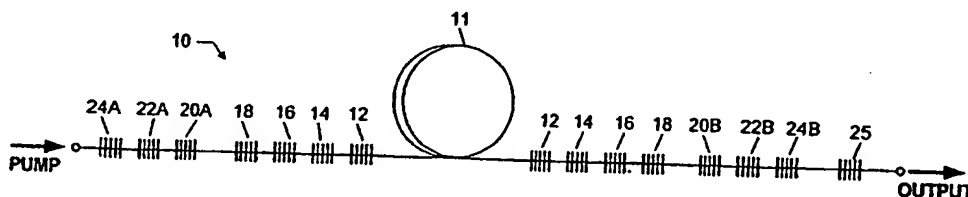
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(72) Inventors: **WAARTS, Robert**; 4543 Northdale Drive, Fremont, CA 94536 (US). **MACCORMACK, Stuart**; Apartment 9, 1329 Park Drive, Mountain View, CA 94040 (US). **GILTNER, David**; 37751 Madera Court, Fremont, CA 04536 (US). **DOMINIC, Vincent**; 38157 Parkmont Drive, Fremont, CA 94536 (US). **SCIFRES, Donald**; 80 Rose Orchard Way, San Jose, CA 95134 (US).

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24 January 2002

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **MULTIPLE WAVELENGTH OPTICAL SOURCES**



(57) Abstract: Optical pumping arrangements are provided for the broadband or multiple wavelength pumping of optical sources. Sources may be based on Raman gain media and may use multiple output couplers to couple out different wavelength ranges. Configurations may also be used. Overlapping resonators cascaded Raman resonators at different wavelengths may be configured to share gain media, and may have separate portions in separate optical paths. Attenuation filters may also be used that are matched to the gain profile of a gain medium, to flatten the gain spectrum and allow equalization of gain to different output wavelengths. In one embodiment, polarization maintaining fiber is used to develop resonant conditions at different wavelengths in different polarization states. Wideband output gratings may be substituted for narrowband gratings to provide CRR configurations with a broader output band. Broadband amplification may also be provided by using a laser source operating in coherence collapse. The multiple wavelength pumping lends itself to a pumping arrangement in which sources at different wavelengths are combined into separate transmission/gain media such as the different fibers of an optical fiber cable.

WO 01/33285 A3

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INTERNATIONAL SEARCH REPORT

International Application No
Pc /US 00/29493

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01S3/081 H01S3/094 H01S3/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, INSPEC, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| X | US 5 878 071 A (DELAVALUX JEAN-MARC PIERRE) 2 March 1999 (1999-03-02) figures 3-5 | 1,2, 13-16 |
| X | US 5 844 927 A (KRINGLEBOTN JON THOMAS) 1 December 1998 (1998-12-01) abstract | 38-40 |
| A | US 5 323 404 A (GRUBB STEPHEN G) 21 June 1994 (1994-06-21) abstract | 1,3,4,18 |
| P,X | EP 0 984 532 A (LUCENT TECHNOLOGIES INC) 8 March 2000 (2000-03-08) abstract | 1-4 |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"A" document member of the same patent family

Date of the actual completion of the international search

13 February 2001

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

GALANTI, M

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 00/29493

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-40

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-40

An optical signal generator comprising an optical pump source, an optical gain medium and two output couplers through which optical energy at two distinct wavelength is emitted.

2. Claims: 41-42

An optical signal generator comprising an optical pump source, an optical gain medium, resonant reflectors to establish a resonant cavity and attenuation element within the resonant cavity for selective wavelength attenuation.

3. Claims: 43-50

An optical amplifier comprising an optical pump source and an optical gain medium, where the pump source comprises a laser operating in the coherence collapse regime

4. Claims: 51-53

An apparatus for optically pumping a plurality of optical fibers comprising a plurality of optical pump sources and a plurality of couplers for receiving optical energy from the pump sources and distribute it among the optical fibers.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

P. /US 00/29493

| Patent document cited in search report | | Publication date | Patent family member(s) | Publication date |
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| US 5878071 | A | 02-03-1999 | NONE | |
| US 5844927 | A | 01-12-1998 | NO 951052 A GB 2299203 A,B | 23-09-1996 25-09-1996 |
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